ZEG-ENERGETYKA

ATS-9

Automatic Transfer Switch Controller

POWER SYSTEM PROTECTION EQUIPMENT

TABLE OF CONTENT

1. MANUFACTURER COMMENTS

1.1. General safety rules

WARNING
During normal operation of the device, some of its parts are under hazardous voltage. Inappropriate or improper use of the device can pose a danger to persons serving, also leads to damage of the device.

1.2. List of applied standards

The device described in this manual has been designed and manufactured for industrial purposes. In the process of development and production, compliance with the standards has been assumed, the fulfilment of which ensures the implementation of the assumed principles and safety measures, provided that the user complies with the installation, commissioning and operating instructions.
This device complies with the essential requirements of the Low Voltage Directive (2014/35/UE) and the Electromagnetic Compatibility Directive (2014/30 / EU), in compliance with the following standards:
Urządzenie będące przedmiotem niniejszej instrukcji zostało zaprojektowane i jest produkowane dla zastosowań przemysłowych.

- **PN-EN 60664-1:2011** Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests
- **PN-EN 61010-1:2011** Safety requirements for electrical equipment for measurement, control, and laboratory use -- Part 1: General requirements
- **PN-EN 60255-26:2014-01** Measuring relays and protection equipment -- Part 26: Electromagnetic compatibility requirements
- **PN-EN 61000-6-2:2008** Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
- **PN-EN 61000-6-4:2008/A12:2012** Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

Related standards:

- **PN-EN 61000-4-2:2011** Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
- **PN-EN 61000-4-4:2013-05** Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
- **PN-EN 61000-4-5:2014-10** Electromagnetic compatibility (EMC) -- Part 4-5: Testing and measurement techniques -- Surge immunity test
- **PN-EN 61000-4-11:2007** Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests
- **PN-EN 60255-22-5:2014-1** Measuring relays and protection equipment -- Part 26: Electromagnetic compatibility requirements

- **PN-EN 60255-22-2:2014-1** Measuring relays and protection equipment -- Part 26: Electromagnetic compatibility requirements
- **PN-EN 60255-22-4:2014-01** Measuring relays and protection equipment -- Part 26: Electromagnetic compatibility requirements
- **PN-IEC 255-11:1994** Electrical relays - Part 11: Interruptions to and alternating component (ripple) in d.c. auxiliary energizing quantity of measuring relays

1.3. Storage and transport

The devices are packed in individual packages to protect them from damage during transport and storage. Equipment should be stored in transport packs, indoors, free of vibration and direct atmospheric, dry, airy, free from harmful vapors and gases. Ambient air temperature should not be below -20 ° C and above + 70 ° C and relative humidity should not exceed 80%.

1.4. Place of installation

The equipment should work in areas free of water, dust and gases and explosive, flammable and chemically active gases where the mechanical exposure is moderate. Installation height should not exceed 2000 m above sea level at an ambient temperature of -5 ° C to + 40 ° C and relative humidity not exceeding 80%.
The device terminal marked with the PE symbol should be connected to ground potential. It is recommended to use stranded wire of cross section min. 2,5 mm^2 and insulation strength min. 500 V with a length of no more than 3 m.

1.5. Device documentation

The set comes with:

- Operating manual
- Test protocol
- Warranty Card

1.6. Disposal

The device has been manufactured mostly from materials that can be recycled or disposed of without endangering the environment. A recalled device may be recaptured for re-processing, provided that its condition corresponds to normal wear and tear. All components that are not regenerated will be removed in an environmentally friendly manner. The device should be disposed of in accordance with local law or passed on to an electronic waste disposal company.

1.7. Warranty and service

The warranty period is 24 months from the date of sale, unless a longer period agreed in the contract or the sales contract.

The warranty covers free of charge removal of defects revealed during use, under the conditions specified in the warranty card.

ZEG-ENERGETYKA SP. Z O.O. gives a guarantee subject to the following conditions:

- the installation and operation of the device should be in accordance with that manual
- the seal on the device's housing must not be affected
- no corrections or changes can be made to the warranty card

The warranty does not cover:

- defects caused in result of inappropriate transport or storage conditions
- defects caused in result of inappropriate installation or operation of the device
- defects caused in result of tampering within the unit, structural modifications, alterations and repairs carried out without the consent of the manufacturer

BUYER TIPS:

- Proper and trouble-free operation of the device requires proper transport, storage, mounting and commissioning, as well as proper operation, maintenance and service.
- The equipment must be handled by properly trained and qualified personnel
- When complaining, please state the reason for the complaint (symptoms related to malfunction) and factory serial number
- After receiving of the complaint confirmation, send the complaint device with the warranty card to the manufacturer's address
- The warranty period is extended by the time of successful complaint filling

1.8. How to order

The order should specify the full name of the device and all the necessary parameters:

- type and version of the device
- supply voltage level

Example of order:

- Automatic Transfer Switch Controller ATS-9
- supply voltage: Upn = 220 V DC

1.9. Manufacturer’s data

ZEG-ENERGETYKA Sp. z o.o. Oddział Tychy
ul. Fabryczna 2
43-100 Tychy
Poland

tel: +48 32 775 07 80
tel/fax: +48 32 775 07 83
NIP: 6381805949
REGON: 242933572
VAT ID-No.: PL6381805949
ING Bank Śląski SA: 72 1050 1344 1000 0090 9570 7718
e-mail: biuro@zeg-energetyka.pl
www.zeg-energetyka.pl

2. TECHNICAL DESCRIPTION

2.1. Application

ATS-9 is automatic transfer switch controller dedicated for LV switchgear. The device is especially dedicated for switchgears serving as auxiliary voltage supply system including diesel generator incoming feeders. An Incoming feeder where unplanned outage occurs is automatically switched off and the controller immediately sends switch on command to one of stand-by supplies according to set priority. Signalling of failures provides the staff precise and immediate information about occurring alert states. The controller provides also event recorder function. The records can be transferred to SCADA system with fiber optic port, RS-485 port or ethernet port. The communication protocol is chosen from one of the available protocols from the list as follows: ZEG, IEC 60870-5-103 or (optional) MODBUS, DNP-3, IEC 61850.
Depending on auxiliary voltage level, the device is provided in two versions:

- ATS-9 of Upn 230V AC/DC
- ATS-9 of Upn 110V AC/DC

2.2. Main features

The main features of ATS-9 are:

- standard rack 19” enclosure 19”/4U/160
- removable front panel with possibility to install in any place
- 48 programmable binary inputs
- 24 relay outputs to control breakers and cooperate with substation telecontrol system
- 16 analog inputs with function of voltage unbalance detection
- 32 LED RGB diodes, fully programmable
- 7 inch LCD display (mimic diagram, settings, configuration)
- watchdog contact in order to signal lack of auxilliary voltage or power supply module failure
- binary inputs for remote confirmation of visual signalling
- input/output modules equipped with screw 16-pins plugs
- possibility of upgrading the device to control any number of supplies
- possibility to block signalling with “Alarm ON/OFF” button
- „Alarm C” button to confirm signalling

- function buttons F1-F6 for setting the priority of supplies
- 8 communication ports: RS-232, RS-485, ST-fibre-optic
- transmission protocol chosen by software: IEC 60870-5-103 or ZEG

2.3. Construction

ATS-9 is enclosured in standard rack cassette of dimensions: 19”/4U/160. Each cassette is equipped with 32 RGB LED diodes for disturbance signalling purposes (Fig. 1). 7” LCD display main task is to visualise of switchgear topology with current breakers states. LCD display serves as interface for settings and configuration purposes as well. The device consist of two main parts:

- the front panel (equipped with RGB LED diodes and 7” LCD display)
- logical unit (enclosured in standard 4U cassette, equipped with input/output modules, supply module, communication module)

Device construction allows to mount separately the front panel and the logical unit. The device can be mounted in any place, while the front panel could be mount in desired place, for example at detachable cabinet frame. On the front panel (Fig. 1) the function buttons F1-F6 are located. Function buttons are used for setting the priority of supply voltage. ON/OFF buttons allows to block alarm and failure signals. Alarm C buttons is used for quitting alarm signals.

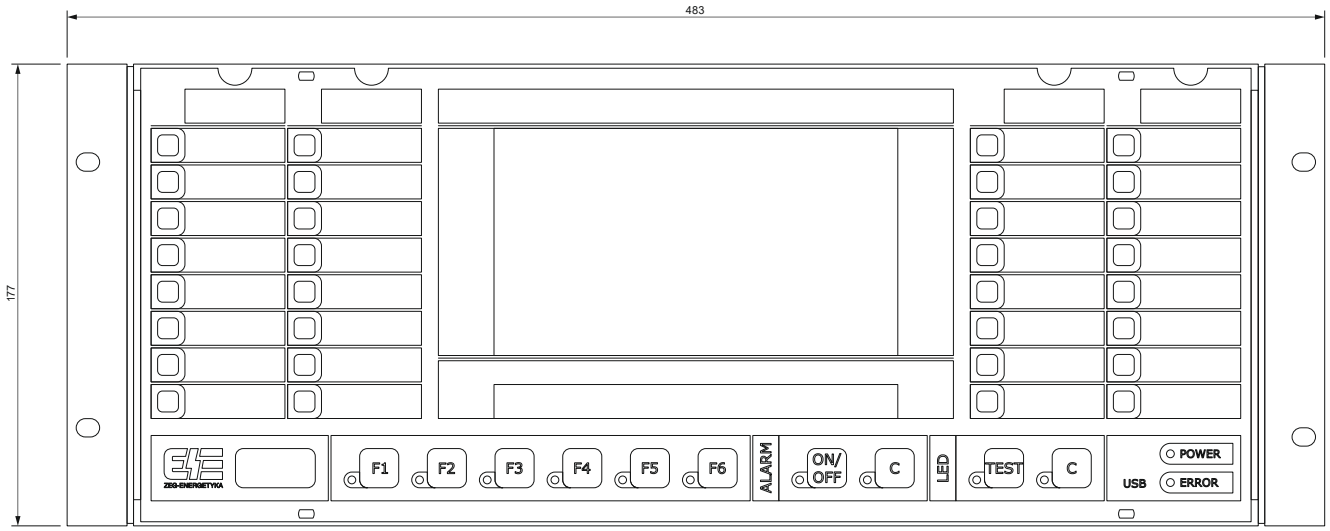


Fig. 1. ATS-9 Automatic Transfer Switch Controller – front panel view

Description of modules designations:

- E1 – cassette 4U no. 1 (E2 – no. 2 etc.)
- H1 – communication module
- Z1 – supply voltage module, the converter of 230 V to 12 V DC
- Y1 – modules of 8 independent outputs for control and signalling purposes
- A1 – modules of 8 inputs dedicated to collect binary signals (input voltage 220 V AC/DC)
- P1 – supply voltage measuring module

The standard hardware configuration of ATS-9 controller is:

- 4 input modules, 8 inputs per each (marked as E1A1 – E1A4)
- 3 output modules, 8 outputs per each (marked as E1Y1 – E1Y3)
- 1 supply voltage module equipped with two independent 12 V transducers (marked as E1Z1)
- 1 communication module (marked as E1H1)
- 1 measuring module for measuring the supply voltage at incoming feeder

Fig. 3 presents the side view of the device. The device consist of two main parts:

- Front panel (left)
- Logical unit (right)

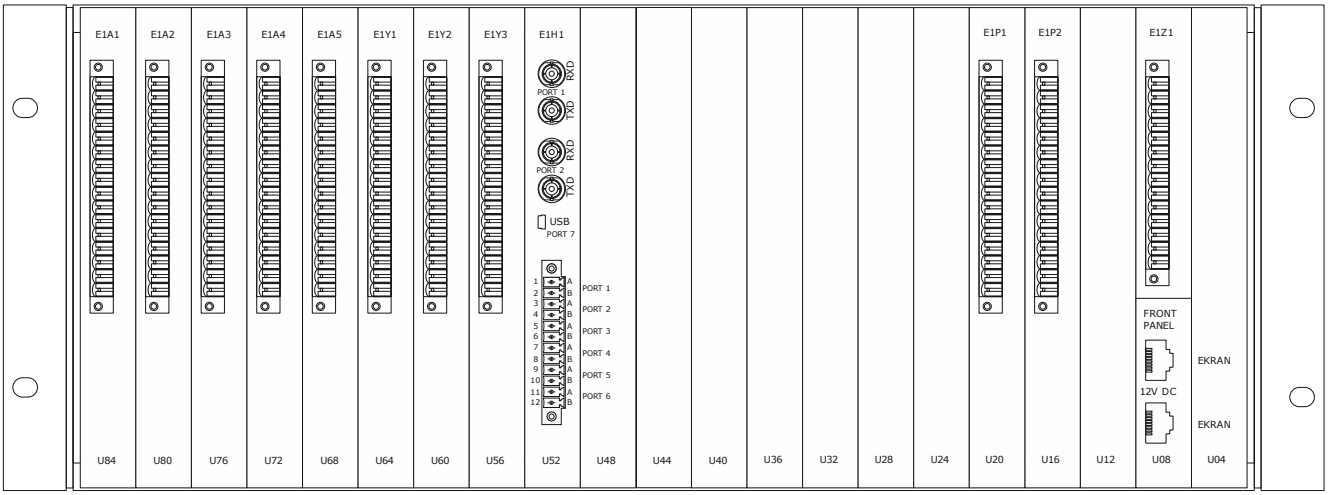


Fig. 2. Terminals arrangement – logical unit back side

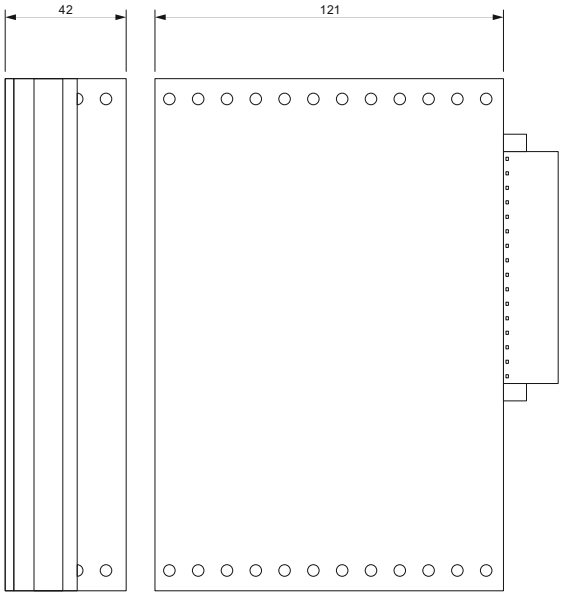


Fig. 3. Side view. The front panel (left) and logical unit (right)

Table 1a. Assigned functions of inputs in cassette 1 (E1) – standard arrangement

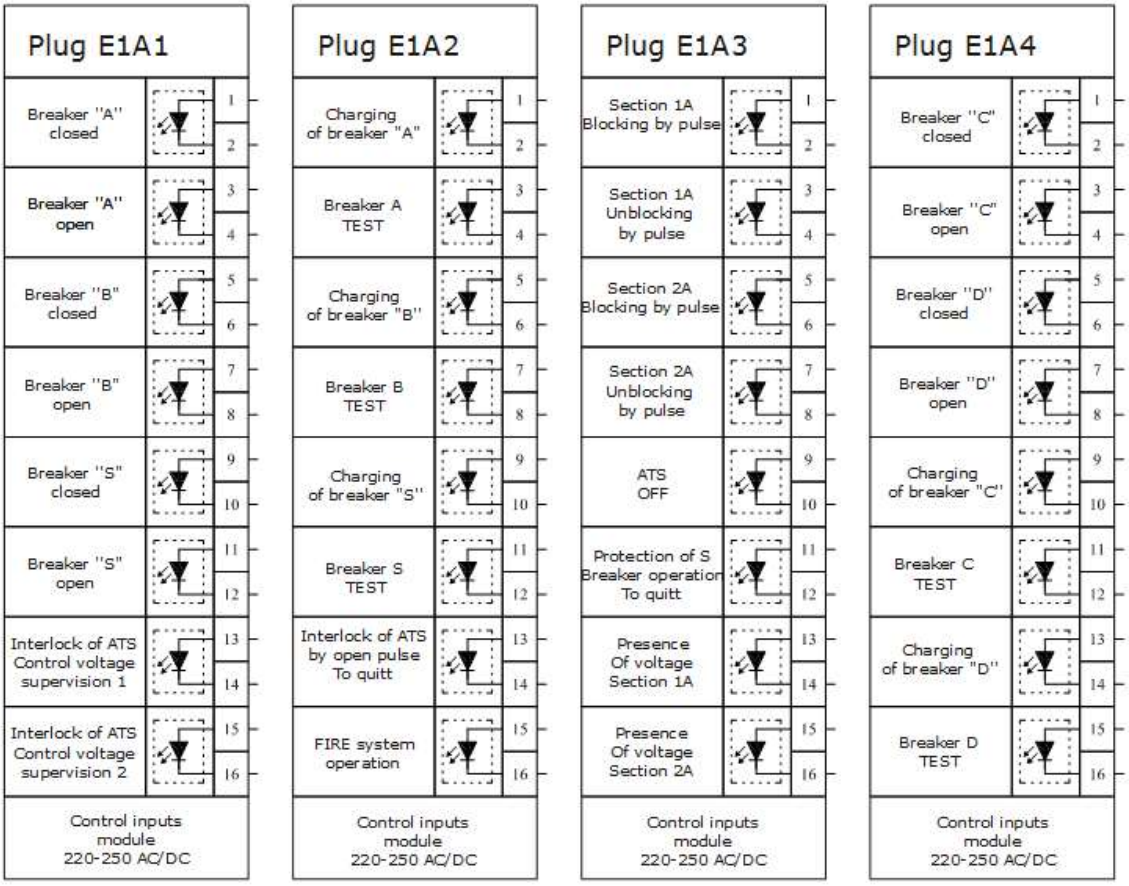


Table 1b. Assigned functions of inputs in cassette 1 (E1) – extra input module arrangement

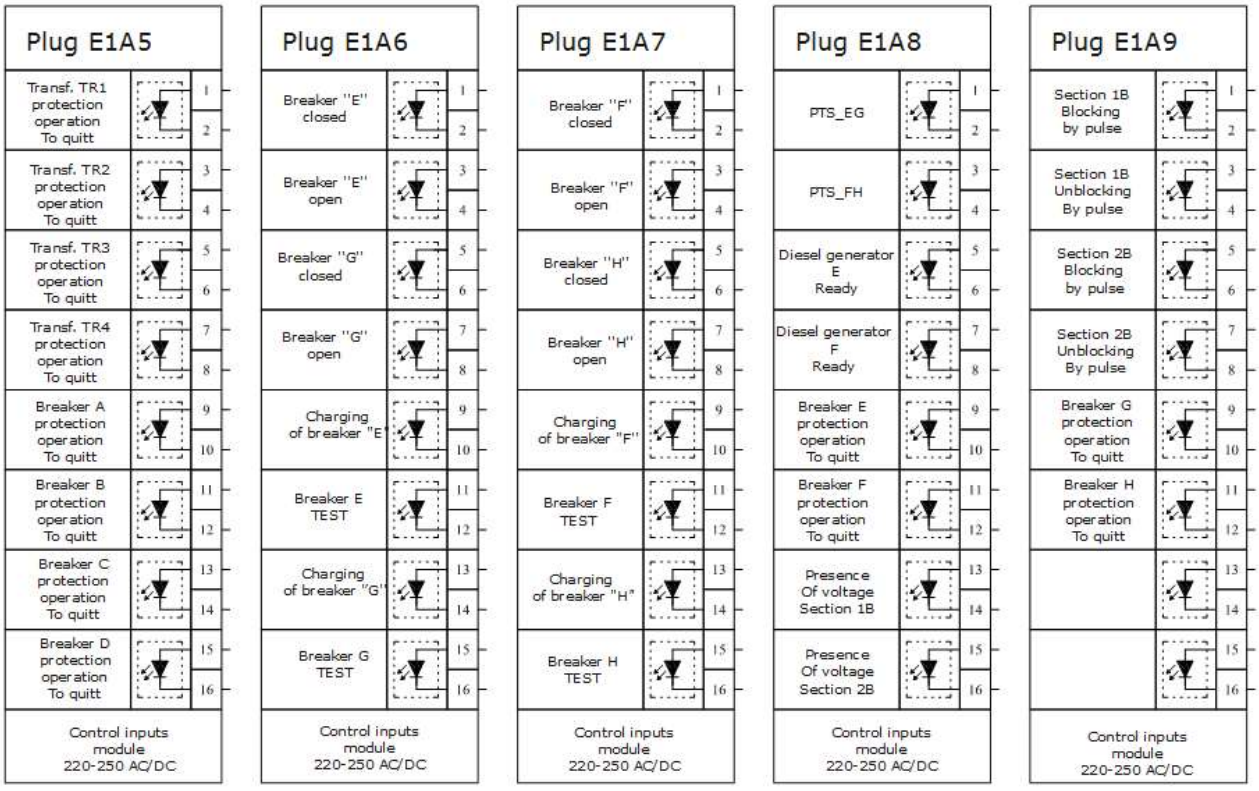


Table 2. Voltage measuring inputs – E1P1 – E1P3 modules

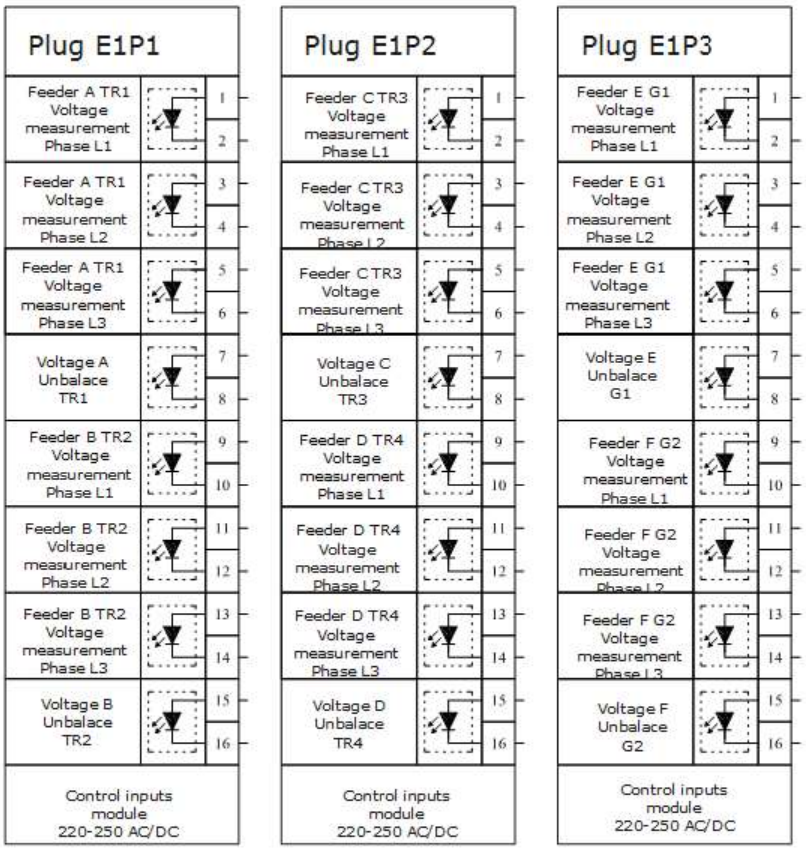


Table 3. Supply module – terminals description

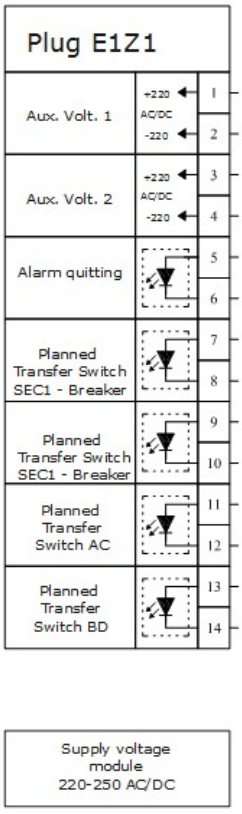
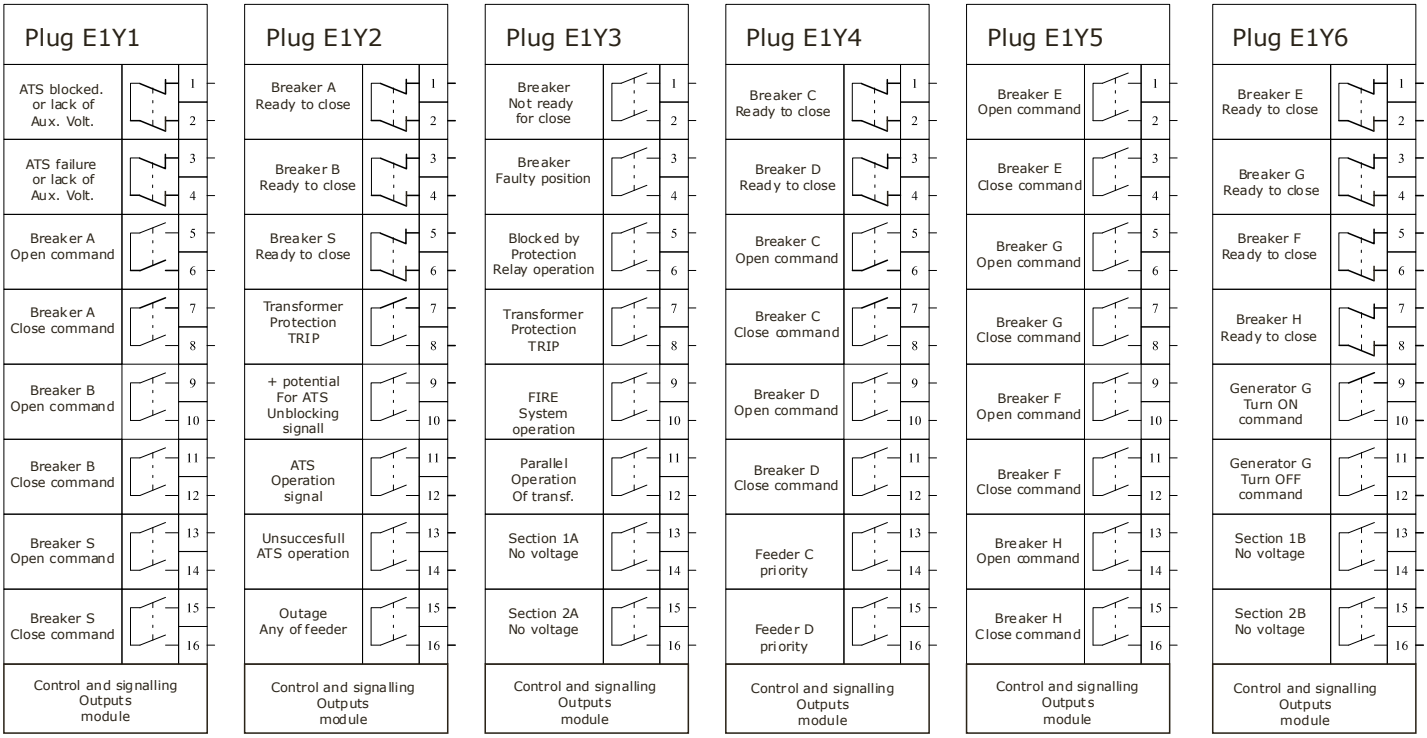


Table 4. Description of output modules in cassette 1 (E1)



3. TECHNICAL DATA

Supply module	Supply voltage	Uz = 2 × 110V/240V, DC/AC (on request)	
	Permissible range of supply voltage fluctuation	±15%	
	Burden in supply voltage	AC	≤ 30VA
		DC	≤ 30W
	Burden in control inputs	AC	≤ 25VA
		DC	≤ 25W
	Permissible supply voltage dip	tp = 50ms	
Signal inputs	Number of inputs (per one cassette)	64 to 128	
	Number of cassettes	1 to 4	
	Insulation	Optical	
	Input voltage (of signal inputs)	Uin = 220V DC / 230V AC (or any different on request)	
	Threshold	0,7 x Uin for DC 0,5 x Uin for AC (on request)	
	Burden in signal inputs	0,3W / input	
	Range of settable time delay	5 ms to 25 s for DC 20 ms to 25 s for AC Default setting: 100ms	
	Time resolution	1 ms	

Communication	Number of communication channels	8
	Port 1	Fiber optic ST / IEC 870-5-103
	Port 2	Fiber optic ST / ZEG protocol
	Port 1/3/4/5/6	RS-485
	Port 7 – front panel	USB / ZEG protocol
	Port 8 – terminals side	USB / ZEG protocol
Insulation	Insulation strenght	2kV, 50Hz, 1 min
	Nominal voltage	250V
	Overvoltage	II
	Ingress protection	IP 40
Operating condition	Ambient temperature	268 ÷ 313K (-5 ÷ +40 °C)
	Relative humidity	< 80%
General data	Dimensions (width x height x depth)	257 mm × 157 mm × 163 mm
	Weight	7 kg

4. FUNCTIONAL PROPERTIES

4.1. Principle of operation

ATS-9 is freely programmable device which by: light indicators on front panel, LCD display and set of relay outputs, signals the current condition of auxiliary voltage switchgear. The signals can be grouped and individually assigned to visual indicators and signalling outputs. Inputs can be picked-up by energising them or by voltage drop. Input signal can be delayed by timer of duration up to 25 sec. Block diagram of the device is shown at Fig. 4 (page 15). Diagram of connection manners of logical unit and front panel are shown at Fig. 5 (page 16). Fig. 5 a presents the logical unit mechanically and electrically connected to front panel by 32 pins connector. At Fig. 6 b the connection by RJ45 wire is shown. In this case, the front panel and logical unit are mount separately. Fig 6 c presents the possibility of connection two front panels with one logical unit by RJ45 wire. This arrangement allows to present the same group of signals in two different places.

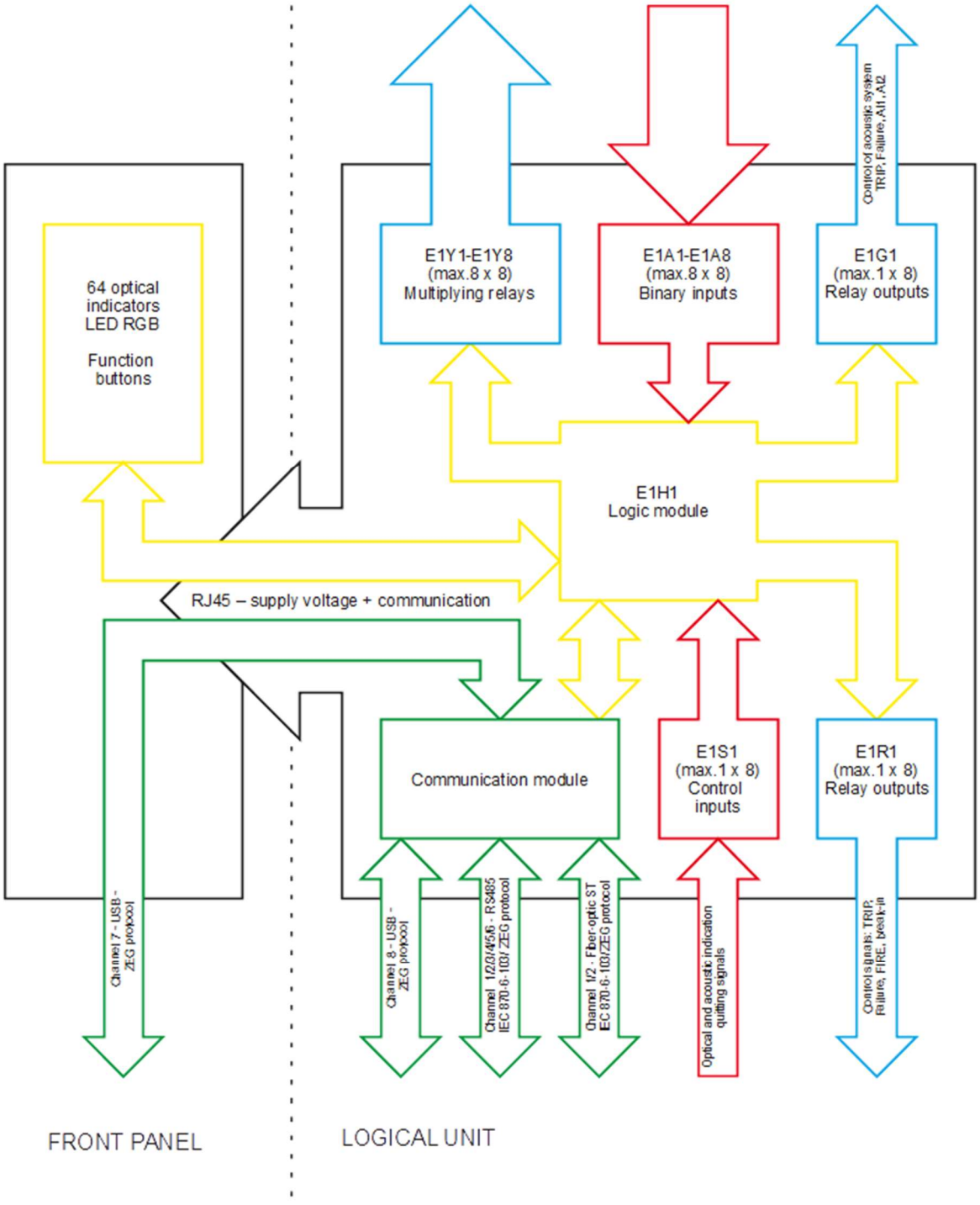


Fig. 4. Block diagram of principle of operation of ATS-9 controller

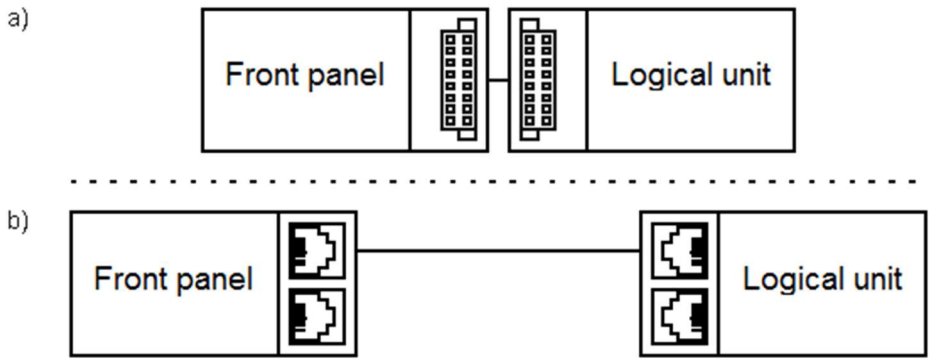


Fig. 5. Block diagram of connection manners of front panel and logical unit

Cooperation with standard switchgear topology

ATS-9 provides voltages supervision on switchgear busbars and feeders. In standard 3-breakers topology (two incoming feedes, two busbar section and coupling breaker) the voltage is supervised in 4 points:

- feeder A
- feeder B
- busbars section A
- busbars section B

In addition, the controller receives the signals of:

- circuit breakers positions
- circuit breakers ready-to-close statuses
- trip signals of each breaker

In normal operation, section A is energised from TR1 transformer and section B is energised by TR2 transformer. Circuit-breakers A and B are closed, while the circuit-breaker S is opened. In case of voltage drop on TR1 or TR2 transformer, the controller automatically starts its operation.

The breaker on which, outage situation occurs, is immidiatelly opened. Than breaker in coupling bay (CB "S") receives the command to close. The time delay of CB "S" close can be adjusted.

In case of switchgear of more than 3 circuit-breakers, the operation is defined individually according to particular case.

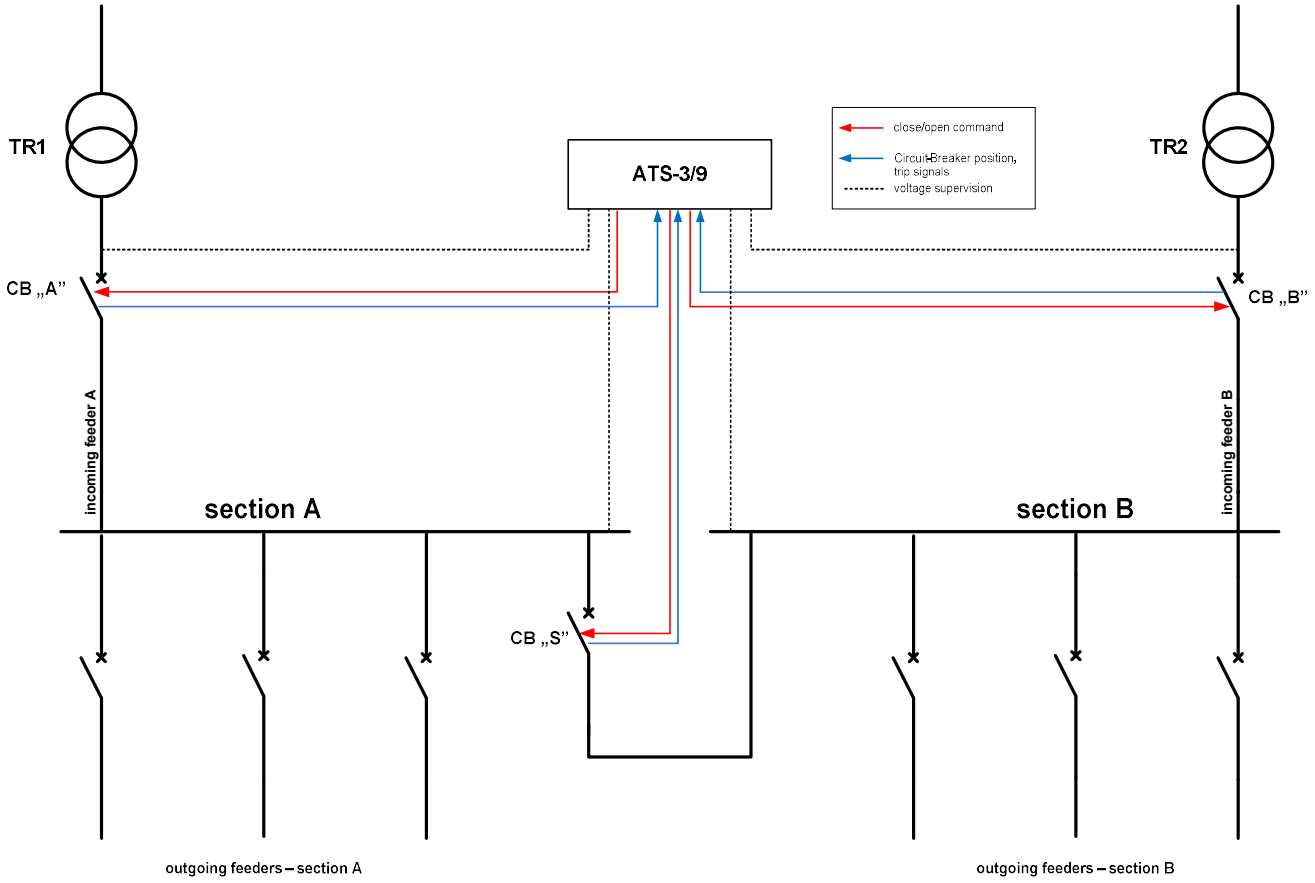


Fig 6. ATS operation in standard two-section switchgear

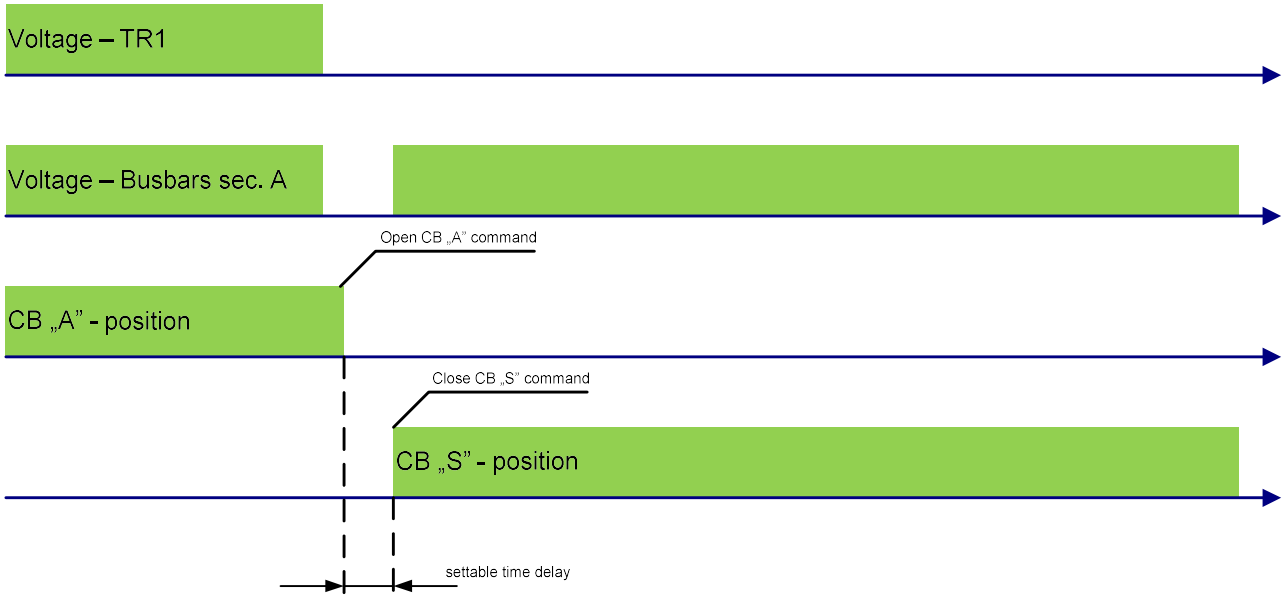


Fig 7. Operation of ATS. Reaction to outage on TR1

Repeating, non-repeating operation mode

ATS controller can be set as: repeating or non-repeating operation mode. In repeating operation mode, the ATS controller immediatelly restores the standard arrangement of the switchgear when voltage on faulted feeder is restored.

In non-repeating operation mode, the ATS controller do not restore the standard arrangment. If the voltages is restored on faulted feeder, the controller waits for acknowledgment signal. Once the controller receives the acknowledgment signal, restores the standard arrangement by sending open command to coupling breaker ("S") and close command to breaker on which, the outage situation occured.

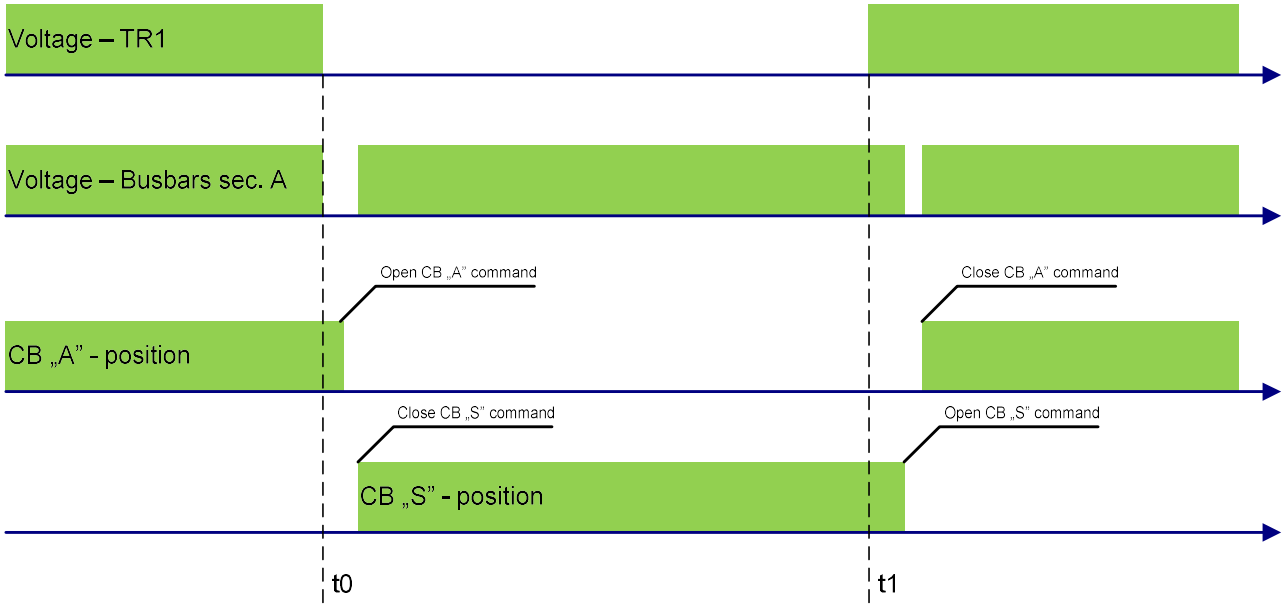


Fig.8 Operation of ATS set to “repeating mode”

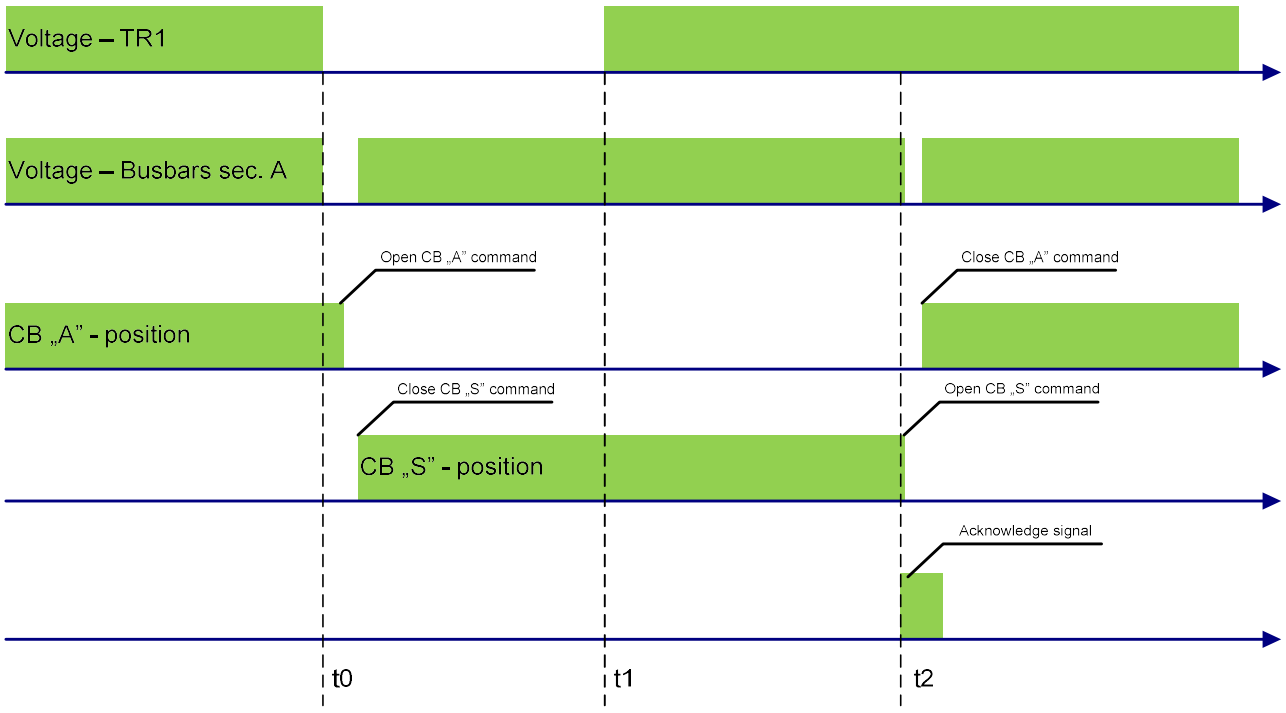


Fig. 9. Operation of ATS set to non-repeating mode

Priority of feeder

The ATS controller allows the user to switch between the feeders. It can be performed by changing the priority of power source. If the priority is set to "energise by TR1", the controller set breakers A and S as close and breaker B as open. If the controller is set to priority "energise by TR2", the controller set breakers B and S as close and breaker A as open. If changing the priority form A to B or B to A, the controller performs operation using an appropriate order. Firstly, opens all the breakers, then closes the breaker suitable for selected priority and finally, closes coupling breaker "S".

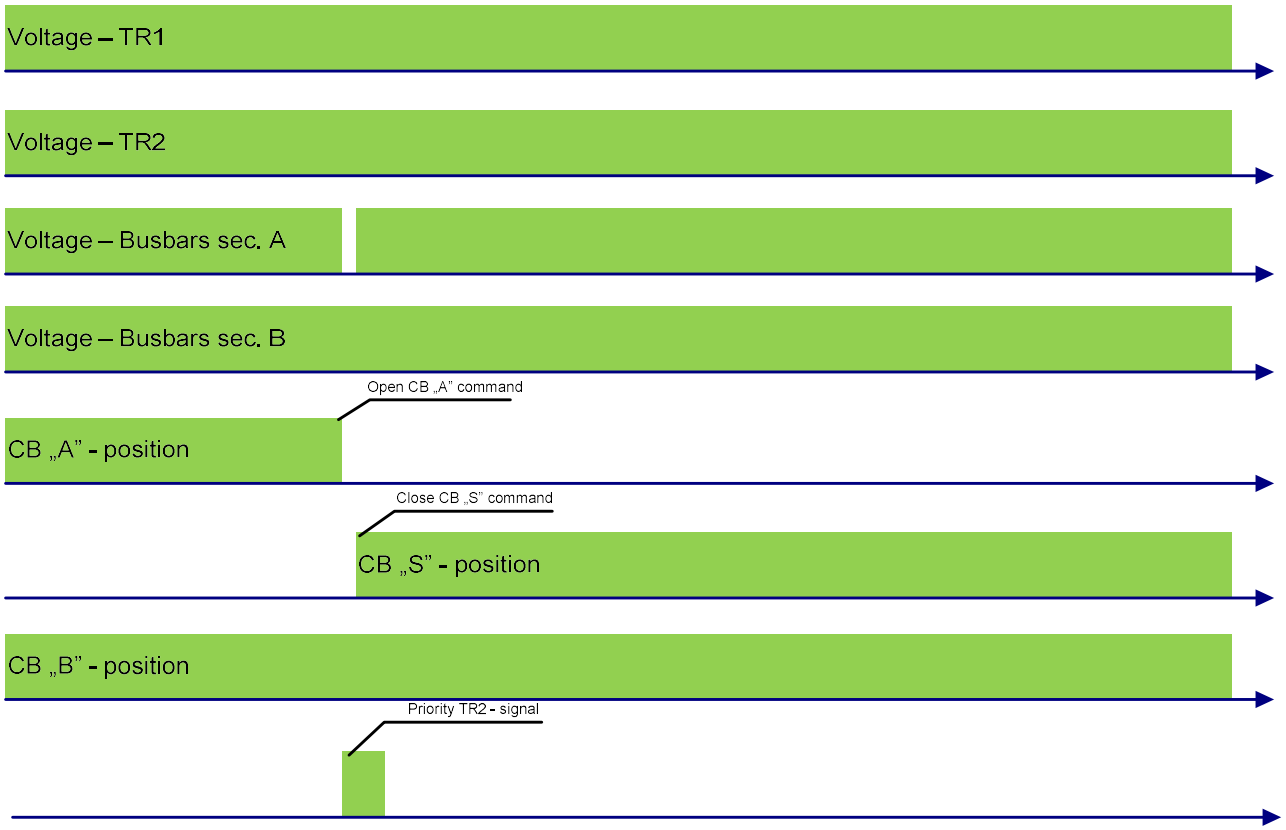


Fig. 10. Operation of ATS. Change od priority of incoming feeder.

Supervision of breakers position

In order to provide reliable operation, the ATS controller needs to receive the information of each breaker in two-byte mode. The controller recognises the position correctly when receives the pair of signals "high" and "low" or "low" and "high" at the same time (XOR gate logic). In case of receiving two "low" or two "high" signals, the controller generates signal "CB ... faulty position" and turn into temporary blocked operation mode - the controller performs no operation. If the controller receives proper pair of signals, automatically returns to ON status and performs all operations according to the situation.

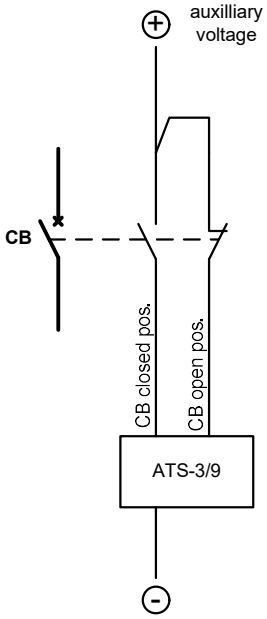


Fig. 11. ATS connection to CB contacts

Table 5. Logical table of CB position supervision

CB closed position	CB open position	CB status in ATS controller
Low	Low	CB faulty position
Low	High	CB open
High	Low	CB closed
High	High	CB faulty position

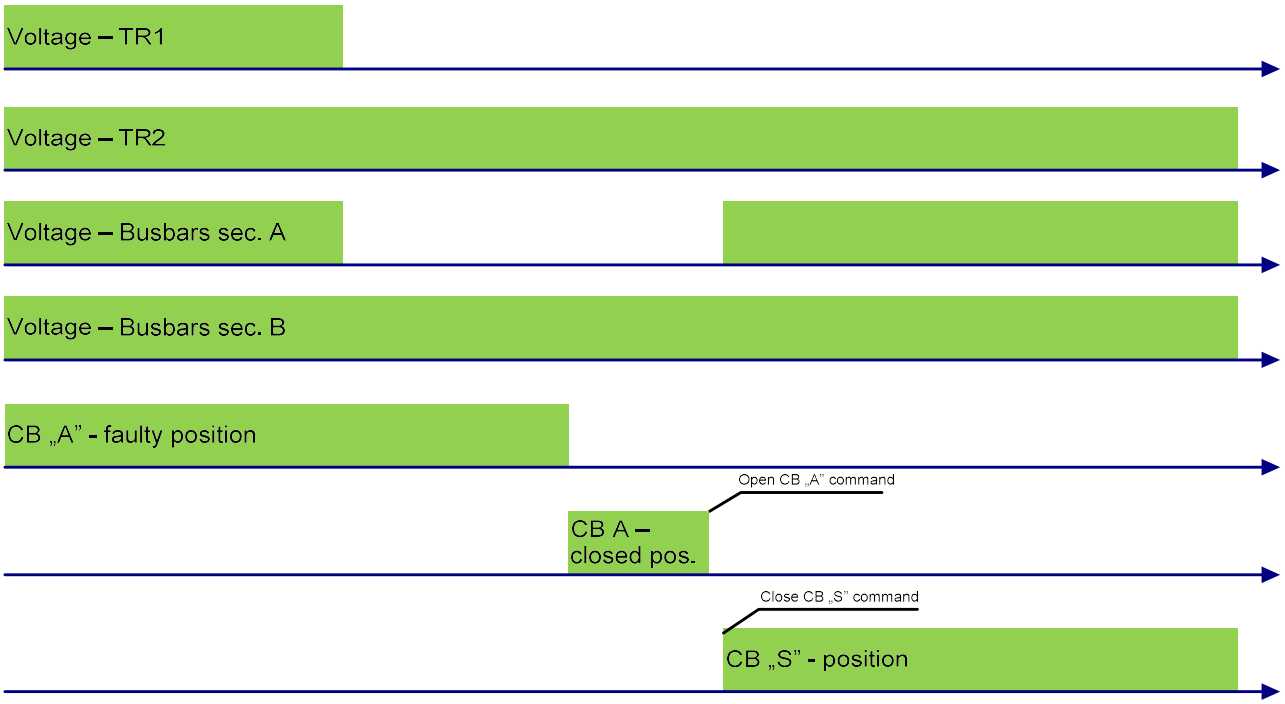


Fig. 12. ATS operation in case of CB faulty position status

Blocking by trip signal

In case of fault on busbars, the CB is open by its overcurrent protection. In such situation, standard operation of ATS controller, would cause "switch-onto-fault" situation. It could result in increasing the danger to staff and equipment. To prevent such situation, the controller receives signal of trip condition of each supervised breaker. In case of trip of any breaker, the controller turns to "latched interlock" and performs no operation. That status must be ackwnoledged by the staff. Until the controller receives the acknowledgment signal, it generates no commands.

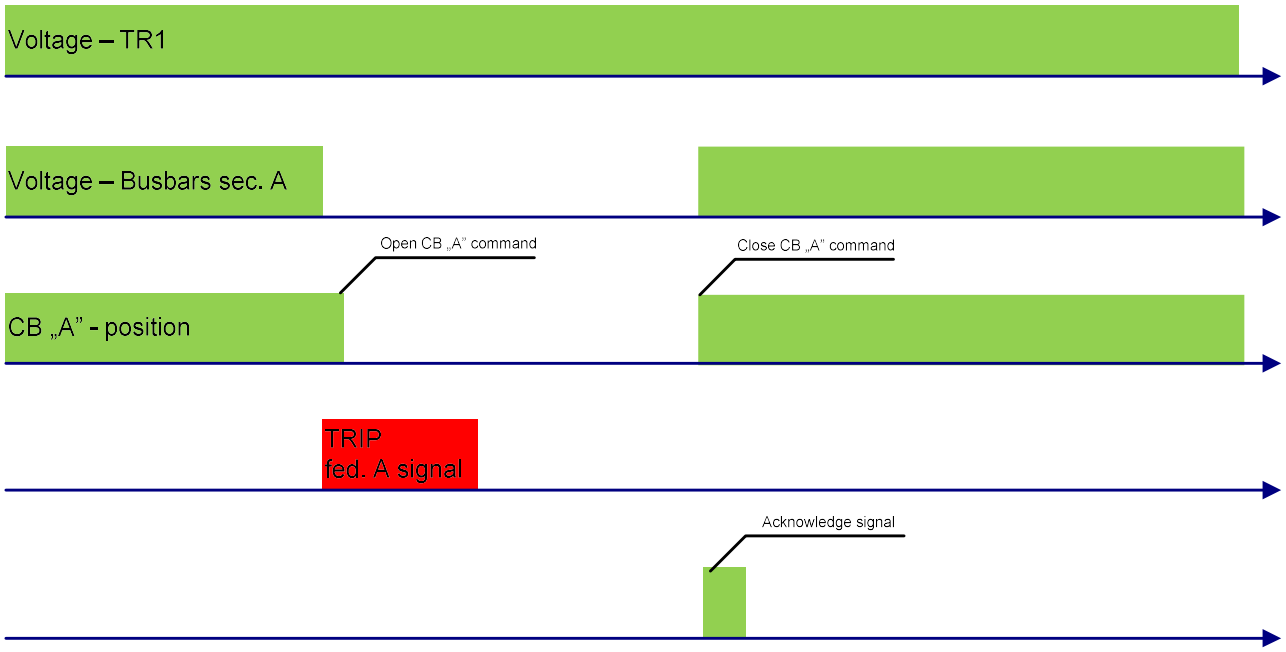


Fig. 13. ATS operation in case of TRIP signal

ATS blocked mode

In order to allow to make intentional outage on switchgear busbars, the controller can be blocked by blocking input. This can be use in case of neccessity of performing maintanance works on switchgear busbars. If the blocking signal is active, the ATS controller performs no operation. The outage can be manually performed by the staff.

Circuit-breaker control circuit fault

In case of unsuccesful operation of Circuit Breaker, the controller sends command 3 times again. If the position of CB does not change to expected position, the controller recognise it as failure in control circuits and generates signal "not ready-to-close".

Protection agains parallel operation of transformers

Standard switchgear wiring do not allow to close all CB at the same time. It would cause the parallel operation of transformer what is in most cases not permitted. If, however, such sitation occurs, the ATS controller immidiatelly sends open command to all breakers. After the time delay, the ATS controller closes proper pair of CB's according to set priority.

4.2. Error codes

The ATS controller provides visual indication of events occurring within the controlled switchgear. Internal device logic covers up to 255 logical nodes of which ~90 are defined as errors or faults. The typical list of errors arriving on device LCD screen is presented in table 6.

Table 6. Error codes on device LCD

Error number on LCD	Error description
15	ATS blocked (to be acknowledged)
16	ATS interlock signal from CB A Trip status
17	ATS interlock signal from CB B Trip status
24	ATS interlock signal from CB S Trip status
25	Circuit Breaker A Trip status
26	Circuit Breaker B Trip status
29	ATS in OFF mode
30	Lack of voltage at TR1 - phase L1
31	Lack of voltage at TR1 - phase L2
32	Lack of voltage at TR1 - phase L3
33	Voltage unbalance at TR1
34	Lack of voltage at TR2 - phase L1
35	Lack of voltage at TR2 - phase L2
36	Lack of voltage at TR2 - phase L3
37	Voltage unbalance at TR2
54	Lack of voltage on section A
55	Lack of voltage on section A
56	Lack of voltage on section B
57	Lack of voltage on section B
58	Circuit Breaker A - not ready-to-close
59	Circuit Breaker B - not ready-to-close
66	Circuit Breaker S - not ready-to-close
67	Circuit Breaker A - control circuit failure
68	Circuit Breaker B - control circuit failure
75	Circuit Breaker S - control circuit failure
76	ATS controller internal failure
77	Lack of voltage in measuring circuit of TR1
78	Lack of voltage in measuring circuit of TR2
79	Circuit Breaker A - faulty position
80	Circuit Breaker B - faulty position
87	Circuit Breaker S - faulty position
88	ATS operation - 5 seconds
91	Lack of auxilliary voltage 1
92	Lack of auxilliary voltage 2

5. INSTALLATION AND COMMISSIONING

5.1. Storage and preparation ATS-9 controller for operation

ATS-9 Automatic Transfer Switch Controller is delivered to the user in packages to ensure protection against external influences that could cause damage. Therefore, do not unpack them for storage. Transport packages

should be transported and reloaded with care, avoiding shocks and maintaining the position specified on their packaging. Storage is possible in indoors, dry (relative humidity <80%), free of corrosive vapors at -20 ºC to +70 ºC.

In order to mount the signalling unit in cabinet doors, the mounting holes has to be made (Fig. 6).

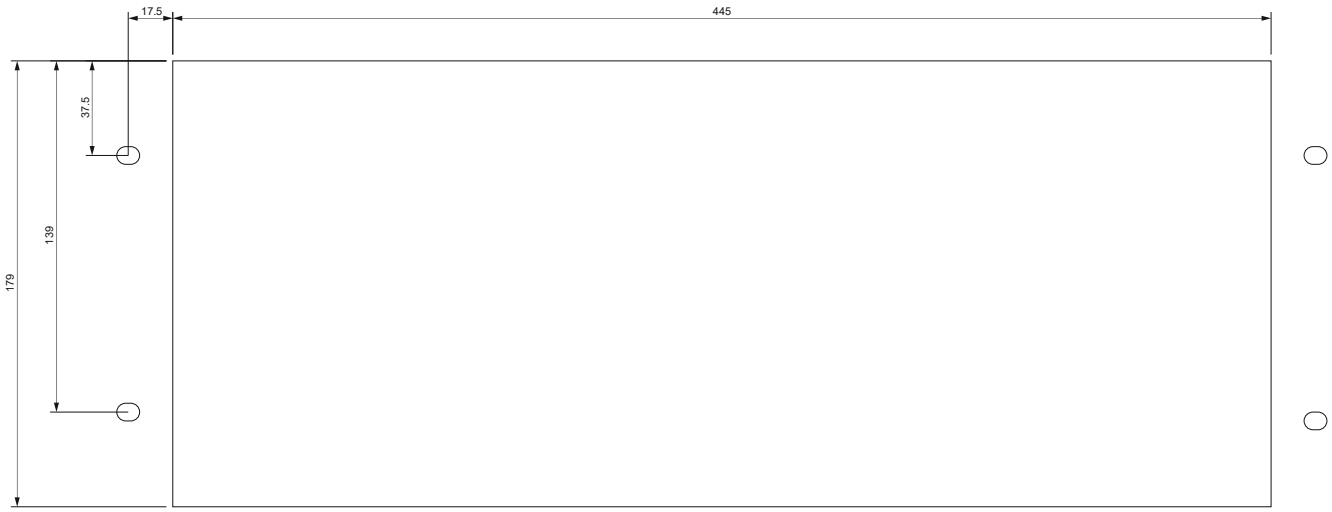


Fig. 6. Mounting holes dimensions

5.2. Operation and maintaince

During routine tests of the controller, its proper work must be checked using the function buttons F1-F6 (picking-up of acoustic signals) and the button “LED test”. Routine tests should be carried out at least once a year.

6. SMIS 2 SOFTWARE

The SC-64 annunciator panel is provided with free software enabling its, configuration, registers reading and visualisation of particular device’s modules. The software can be downloaded from manufacturer’s web site under following address:

www.zeg-energetyka.pl/en/product/smis/

NOTICES

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NOTICES

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